We Claim:

1. A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

constructing a three dimensional model of the joint intra-operatively using the surgical navigation system based on the patient's anatomical landmarks;

preparing the limb to receive a stem using the three dimensional model;

placing the stem in the limb; and

determining the joint range of motion of the joint.

2. The method of claim 1 wherein the ball and socket joint is a hip and wherein the method includes the additional steps of:

preparing the socket to receive a cup using the three dimensional model; and

placing the cup in the socket.

3. The method of claim 1 wherein the ball and socket joint is a shoulder.

4. The method of claim 1 wherein the three dimensional model is constructed based on non-invasively acquired landmarks.

5. The method of claim 1 wherein the three dimensional model is constructed based on invasively acquired landmarks.

6. The method of claim 1 wherein the three dimensional model is based in part on a neutral positioning of the limb.

7. The method of claim 1 wherein method includes the additional step of determining the stability of the joint.

8. The method of claim 1 wherein method includes the additional step of verifying the three dimensional model.

9. The method of claim 1 wherein the preparing of the limb is conducted by aligning a resection guide relative to a proximal shaft axis, a sagittal plane, and coronal plane as determined by the three dimensional model.

10. The method of claim 9 wherein the aligning of the resection guide is also relative to dimensions of a proposed implant and based on pre-surgically determined changes in geometry of the joint.

11. The method of claim 2 wherein the socket is an acetabulum and wherein the preparing of the socket is conducted by reaming of the acetabulum to a predetermined orientation guided by the surgical navigation system relative to the three dimensional model.

12. The method of claim 2 wherein the socket is an acetabulum and wherein the preparing of the socket is reaming of the acetabulum to a depth guided by the surgical navigation system relative to the three dimensional model.

13. The method of claim 12 wherein the depth relates to a medial wall of the acetabulum.

14. The method of claim 2 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined depth guided by the surgical navigation system relative to the three dimensional model.

15. The method of claim 2 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system relative to the three dimensional model.

16. The method of claim 2 wherein the inserting of the cup is conducted by impacting the cup to a depth guided by the surgical navigation system relative to the three dimensional model.

17. The method of claim 2 wherein the inserting of the cup is conducted by impacting the acetabular cup to an orientation guided by the surgical navigation system using the three dimensional model.

18. The method of claim 2 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

19. The method of claim 2 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to an orientation guided by the surgical navigation system using the three dimensional model.

20. The method of claim 18 wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

21. The method of claim 1 wherein the inserting of the stem is conducted by impacting the stem to a depth guided by the surgical navigation system using the three dimensional model.

22. The method of claim 1 wherein the inserting of the stem is conducted by impacting the stem to an orientation along a proximal shaft axis and a sagittal plane and a coronal plane guided by the surgical navigation system using the three dimensional model.

23. The method of claim 1 wherein method includes the additional step of determining the stability of the joint and the joint stability is determined based on the three dimensional model and on a center of the cup and the stem.

24. The method of claim 2 wherein the range of motion is determined based on the three dimensional model and a center of the cup and the stem.

25. The method of claim 1 including the additional step of displaying a result of implant geometry changes on range of motion and joint stability.

26. The method of claim 25 wherein the results of the implant geometry changes on range of motion and stability are determined based on the three dimensional model and a center of the cup and the stem.

27. The method of claim 1 including the additional step of performing a virtual trial using the three dimensional model of the joint and using a database of joint implant components to chose implant components and virtually preparing the joint to receive the implant components.

28. A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

constructing a three dimensional model of the joint intra-operatively using the surgical navigation system based on the patient's anatomical landmarks;

preparing the limb to receive a stem using the three dimensional model;

placing the stem in the limb; and

determining the stability of the joint.

29. The method of claim 28 wherein the ball and socket joint is a hip and wherein the method includes the additional steps of:

preparing the socket to receive a cup using the three dimensional model; and placing the cup in the socket.

30. The method of claim 28 wherein the ball and socket joint is a shoulder.

31. The method of claim 28 wherein the three dimensional model is constructed based on non-invasively acquired landmarks.

32. The method of claim 28 wherein the three dimensional model is constructed based on invasively acquired landmarks.

33. The method of claim 28 wherein the three dimensional model is based in part on a neutral positioning of the limb.

34. The method of claim 28 wherein method includes the additional step of determining the range of motion of the joint.

35. The method of claim 28 wherein method includes the additional step of verifying the three dimensional model.

36. The method of claim 28 wherein the preparing of the limb is conducted by aligning a resection guide relative to a proximal shaft axis and a sagittal plane and coronal plane as determined by the three dimensional model.

37. The method of claim 36 wherein the aligning of the resection guide is also relative to dimensions of a proposed implant and based on pre-surgically determined changes in geometry of the joint.

38. The method of claim 29 wherein the socket is an acetabulum and wherein the preparing of the socket is conducted by reaming of the acetabulum to a predetermined orientation guided by the surgical navigation system relative to the three dimensional model.

39. The method of claim 29 wherein the socket is an acetabulum and wherein the preparing of the socket is reaming of the acetabulum to a depth guided by the surgical navigation system relative to the three dimensional model.

40. The method of claim 39 wherein the depth relates to a medial wall of the acetabulum.

41. The method of claim 29 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined depth guided by the surgical navigation system relative to the three dimensional model.

42. The method of claim 29 wherein the limb is a femur and wherein the preparing of the limb is conducted by broaching the femur to a predetermined orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system relative to the three dimensional model.

43. The method of claim 29 wherein the inserting of the cup is conducted by impacting the cup to a depth guided by the surgical navigation system relative to the three dimensional model.

43. The method of claim 29 wherein the inserting of the cup is conducted by impacting the acetabular cup to an orientation guided by the surgical navigation system using the three dimensional model.

45. The method of claim 29 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

46. The method of claim 29 wherein the socket is an acetabulum and wherein the inserting of the cup is conducted by impacting the cup to an orientation guided by the surgical navigation system using the three dimensional model.

47. The method of claim 45 wherein the inserting of the cup is conducted by impacting the cup to a depth that relates to a previously recorded final depth of the prepared acetabulum.

48. The method of claim 28 wherein the inserting of the stem is conducted by impacting the stem to a depth guided by the surgical navigation system using the three dimensional model.

49. The method of claim 28 wherein the inserting of the stem is conducted by impacting the stem to an orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system using the three dimensional model.

50. The method of claim 29 wherein method includes the additional step of determining the range of motion of the joint and the range of motion is determined based on the three dimensional model and on a center of the cup and the stem.

51. The method of claim 28 including the additional step of displaying a result of implant geometry changes on joint stability.

52. The method of claim 51 wherein the results of the implant geometry changes on stability are determined based on the three dimensional model and a center of the cup and the stem.

53. The method of claim 28 including the additional step of performing a virtual trial using the three dimensional model of the joint and using a database of joint implant components to chose implant components and virtually preparing the joint to receive the implant components.

54. A system for assisting in the performance of total arthroplasty of a ball and socket joint on a patient comprising:

a surgical navigation system;

a first circuit to construct a three dimensional model of the ball and socket joint intra-operatively using the surgical navigation system based on the patient's anatomical landmarks;

a first tool to prepare a limb to receive a stem, wherein the first tool can be tracked by the surgical navigation system to determine the position and orientation of the first tool and wherein the position and orientation of the first tool is tracked relative to the three dimensional model;

a second tool to place the stem in the limb, wherein the second tool can be tracked by the surgical navigation system to determine the position and orientation of the second tool and wherein the position and orientation of the second tool is tracked relative to the three dimensional model; and

a second circuit to determine a joint range of motion.

55. The system of claim 54 wherein the ball and socket joint is a hip joint and wherein the limb is a femur, including a third tool to prepare an acetabulum that can be tracked by the surgical navigation system to determine the position and orientation of the third tool relative to the three dimensional model; and a fourth tool to place an implant into the prepared acetabulum wherein the fourth tool can be tracked by the surgical navigation system to determine the position and orientation of the fourth tool relative to the three dimensional model.

56. The system of claim 54 wherein the first circuit constructs the three dimensional model based on non-invasively acquired landmarks.

57. The system of claim 54 wherein the first circuit constructs the three dimensional model based on invasively acquired landmarks.

58. The system of claim 55 including a resection guide to assist in the resection of the femur wherein the resection guide can be tracked by the surgical navigation system to align the resection guide relative to a proximal shaft axis, a sagittal plane, and a coronal plane determined by the three dimensional model.

59. The system of claim 55 including a resection guide to assist in the resection of a neck of the femur that can be tracked by the surgical navigation system relative to a proximal shaft axis, a sagittal plane, and coronal plane and relative to the dimensions of a proposed implant and on pre-surgically determined changes in geometry of the hip joint.

60. The system of claim 55 wherein the third tool reams the acetabulum to a depth guided by the surgical navigation system relative to the three dimensional model.

61. The system of claim 55 wherein the third tool reams the acetabulum to a predetermined orientation guided by the surgical navigation system relative to the three dimensional model.

62. The system of claim 55 wherein the first tool broaches the femur to a predetermined depth guided by the surgical navigation system relative to the three dimensional model.

63. The system of claim 55 wherein the first tool broaches the femur to a predetermined orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system relative to the three dimensional model.

64. The system of claim 55 wherein the fourth tool inserts the implant to a depth guided by the surgical navigation system relative to the three dimensional model.

65. The system of claim 55 wherein the fourth tool inserts the implant to an orientation guided by the surgical navigation system using the three dimensional model.

66. The system of claim 54 wherein the second tool inserts the stem to a depth guided by the surgical navigation system using the three dimensional model.

67. The system of claim 54 wherein the second tool inserts the stem to an orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system using the three dimensional model.

68. The system of claim 55 wherein the second circuit determines hip joint range of motion based on the three dimensional model and a center of the implant and the stem.

69. The system of claim 55 wherein a third circuit determines the stability of the hip joint based on the three dimensional model and a center of the implant and the stem.

70. The system of claim 69 including a fourth circuit to display a result of implant geometry changes on range of motion and hip stability.

71. The system of claim 54 that includes a third circuit to verify the three dimensional model.

72. A system for assisting in the performance of total arthroplasty of a ball and socket joint on a patient comprising:

a surgical navigation system;

a first circuit to construct a three dimensional model of the ball and socket joint intra-operatively using the surgical navigation system based on the patient's anatomical landmarks;

a first tool to prepare a limb to receive a stem, wherein the first tool can be tracked by the surgical navigation system to determine the position and orientation of the first tool and wherein the position and orientation of the first tool is tracked relative to the three dimensional model;

a second tool to place the stem in the limb, wherein the second tool can be tracked by the surgical navigation system to determine the position and orientation of the second tool and wherein the position and orientation of the second tool is tracked relative to the three dimensional model; and

a second circuit to determine a stability of the joint.

73. The system of claim 72 wherein the ball and socket joint is a hip joint and wherein the limb is a femur, including a third tool to prepare an acetabulum that can be tracked by the surgical navigation system to determine the position and orientation of the third tool relative to the three dimensional model; and a fourth tool to place an implant into the prepared acetabulum wherein the fourth tool can be tracked by the surgical navigation system to determine the position and orientation of the fourth tool relative to the three dimensional model.

74. The system of claim 72 wherein the first circuit constructs the three dimensional model based on non-invasively acquired landmarks.

75. The system of claim 72 wherein the first circuit constructs the three dimensional model based on invasively acquired landmarks.

76. The system of claim 73 including a resection guide to assist in the resection of the femur wherein the resection guide can be tracked by the surgical navigation system to align the resection guide relative to a proximal shaft axis, a sagittal plane, and a coronal plane determined by the three dimensional model.

77. The system of claim 73 including a resection guide to assist in the resection of a neck of the femur that can be tracked by the surgical navigation system relative to a proximal shaft axis, a sagittal plane, and coronal plane and relative to the dimensions of a proposed implant and on pre-surgically determined changes in geometry of the hip joint.

78. The system of claim 73 wherein the third tool reams the acetabulum to a depth guided by the surgical navigation system relative to the three dimensional model.

79. The system of claim 73 wherein the third tool reams the acetabulum to a predetermined orientation guided by the surgical navigation system relative to the three dimensional model.

80. The system of claim 73 wherein the fist tool broaches the femur to a predetermined depth guided by the surgical navigation system relative to the three dimensional model.

81. The system of claim 73 wherein the first tool broaches the femur to a predetermined orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system relative to the three dimensional model.

82. The system of claim 73 wherein the fourth tool inserts the implant to a depth guided by the surgical navigation system relative to the three dimensional model.

83. The system of claim 73 wherein the fourth tool inserts the implant to an orientation guided by the surgical navigation system using the three dimensional model.

84. The system of claim 72 wherein the second tool inserts the stem to a depth guided by the surgical navigation system using the three dimensional model.

85. The system of claim 72 wherein the second tool inserts the stem to an orientation along a proximal shaft axis, a sagittal plane, and a coronal plane guided by the surgical navigation system using the three dimensional model.

86. The system of claim 73 wherein the second circuit determines the stability of the hip joint based on the three dimensional model and a center of the implant and the stem.

87. The system of claim 73 including a fourth circuit to display a result of implant geometry changes on range of motion and hip stability.

88. The system of claim 72 that includes a third circuit to verify the three dimensional model.

89. A method of performing a total arthroplasty of a ball and socket joint of a patient using a surgical navigation system wherein the joint has a socket and a limb having a ball shaped head at a proximal end of the limb near the socket comprising the steps of:

constructing a three dimensional model of the joint;

providing a virtual trial of the joint using the three dimensional model of the joint and data relating to implant components chosen from a database of joint implant components;

preparing a limb to receive a stem implant using the three dimensional model; and

placing the stem implant within the prepared limb.

90. The method of claim 89 wherein the ball and socket joint is a hip and wherein the method includes the additional steps of:

preparing the socket to receive a cup using the three dimensional model; and

placing the cup in the socket.

91. The method of claim 89 wherein the ball and socket joint is a shoulder.

92. The method of claim 89 wherein the three dimensional model is constructed based on non-invasively acquired landmarks.

93. The method of claim 89 wherein the three dimensional model is constructed based on invasively acquired landmarks.

94. The method of claim 89 wherein the three dimensional model is based in part on a neutral positioning of the limb.

95. The method of claim 89 wherein method includes the additional step of determining the stability of the joint.

96. The method of claim 89 wherein method includes the additional step of verifying the three dimensional model.

97. The method of claim 89 wherein the three dimensional model of the joint is constructed intra-operatively using the surgical navigation system based on landmarks on a patient.

98. The method of claim 89 wherein the three dimensional model of the joint is constructed based on pre-operative scan data.

99. The method of claim 89 wherein the virtual trial is conducted prior to the preparation of the joint.

100. The method of claim 89 wherein the virtual trial is conducted at any time during the preparation of the joint.

101. The method of claim 89 wherein the virtual trial is conducted after to the preparation of the joint.

102. The method of claim 89 wherein a trial reduction is performed prior to placing an implant into the prepared joint.

103. The method of claim 89 including the additional step of displaying a result of implant geometry changes on joint stability.

104. The method of claim 103 wherein the range of motion is determined based on the three dimensional model and a center of the stem.

105. The method of claim 89 including the additional step of displaying a result of implant geometry changes on joint range of motion.

106. The method of claim 105 wherein the results of implant geometry changes on range of motion are determined based on the three dimensional model and a center of the stem.

107. A system for performing a total arthroplasty of a ball and socket joint of a patient comprising:

a surgical navigation system;

a first circuit to construct a three dimensional model of the joint;

a second circuit to provide a virtual trial of the joint using the three dimensional model of the joint and data relating to implant components chosen from a database of joint implant components;

a first tool to prepare a limb to receive a stem, wherein the first tool can be tracked by the surgical navigation system to determine the position and orientation of the first tool and wherein the position and orientation of the first tool is tracked relative to the three dimensional model; and

a second tool to place the stem in the limb, wherein the second tool can be tracked by the surgical navigation system to determine the position and orientation of the second tool and wherein the position and orientation of the second tool is tracked relative to the three dimensional model.

108. The system of claim 107 wherein the ball and socket joint is a hip joint and wherein the limb is a femur, including a third tool to prepare an acetabulum that can be tracked by the surgical navigation system to determine the position and orientation of the third tool relative to the three dimensional model; and a fourth tool to place an implant into the prepared acetabulum wherein the fourth tool can be tracked by the surgical navigation system to determine the position and orientation of the fourth tool relative to the three dimensional model.

109. The system of claim 107 wherein the ball and socket joint is a shoulder.

110. The system of claim 107 wherein the three dimensional model is constructed based on non-invasively acquired landmarks.

111. The system of claim 107 wherein the three dimensional model is constructed based on invasively acquired landmarks.

112. The system of claim 107 wherein the three dimensional model is based in part on a neutral positioning of the limb.

113. The system of claim 107 including a third circuit to determine the stability of the joint.

114. The system of claim 107 including a third circuit to verifying the three dimensional model.

115. The system of claim 107 wherein the three dimensional model of the joint is constructed intra-operatively using the surgical navigation system based on landmarks on a patient.

116. The system of claim 107 wherein the three dimensional model of the joint is constructed based on pre-operative scan data.

117. The system of claim 107 including a third circuit to display a result of implant geometry changes on joint stability.

118. The system of claim 117 wherein the joint stability is determined based on the three dimensional model and a center of the stem.

119. The system of claim 107 including a third circuit to display a result of implant geometry changes on joint range of motion.

120. The system of claim 119 wherein the results of implant geometry changes on range of motion are determined based on the three dimensional model and a center of the stem.

121. A device to be used with a tracking device to locate the center line of a canal of a limb comprising of an elongate body that can be inserted into the canal, a series of outwardly biased surfaces spaced around the elongate body and an interface attached to the body to enable a locating device capable of being tracked by a surgical navigation system to be affixed to the device.

122. A device to be used with a tracking device to locate a level of resection of a neck of a limb comprising a flat guide surface, a handle, and an interface attached to the handle to enable a locating device capable of being tracked by a surgical navigation system to be attached to the device.